NON-PUBLIC?: N
ACCESSION #: 9506160342
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Fort Calhoun Station Unit No. 1 PAGE: 1 OF 5

DOCKET NUMBER: 05000285

TITLE: Manual Reactor Trips Due to Water Leakage Into Reactor Coolant Pump Lube Oil
EVENT DATE: 05/11/95 LER #: 95-003-00 REPORT DATE: 06/13/95

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: James R. Geschwender, Station Licensing TELEPHONE: (402) 533-6857

COMPONENT FAILURE DESCRIPTION:
CAUSE: E SYSTEM: AB COMPONENT: CLR MANUFACTURER: B217
REPORTABLE NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On May 11, 1995, it was determined that the upper oil reservoir lube oil cooler heat exchanger for the Reactor Coolant Pump (RCP) RC-3D motor had developed a leak. The leak was allowing Component Cooling Water (CCW) into the lube oil system for the RCP motor. To minimize possible damage to the motor bearings, the reactor was manually tripped (from 100 percent power) at 1105 and RC-3D was secured. Following eddy current testing and plugging of several heat exchanger tubes, the plant was returned to power operation on May 15, 1995.

On May 23, 1995, a similar leak developed in the same lube oil cooler. The reactor was again manually tripped (from 97 percent power) at 0029 on May 24, 1995 and RC-3D was secured.

Destructive examination indicates that the failures involved intergranular stress corrosion cracking associated with nitrites in the

CCW. The tubes had been in service since initial plant startup in 1973.

The tube bundles for all four RCP motor upper oil reservoir lube oil coolers have been replaced. Additional corrective actions will include determining appropriate actions to ensure adequate heat exchanger reliability.

END OF ABSTRACT

BACKGROUND

The Fort Calhoun Station (FCS) Reactor Coolant System (RCS) includes four reactor coolant pumps (RC-3A, RC-3B, RC-3C and RC-3D). Component Cooling Water (CCW) is circulated through the tube bundles in heat exchangers for each pump motor to cool the motor bearing lubricating oil.

The upper oil reservoir lube oil cooler heat exchangers were manufactured by Berlin Chapman, Inc. (Model WHX-865-2530-150-150). They are horizontal, straight tube heat exchangers with an 18 pass cross-flow shell side (oil) and a double pass tube side (CCW). The tube bundles consist of 72 Wolverine Trufin tubes with an integral fin design.

EVENT DESCRIPTION

At approximately 0640 on May 11, 1995, with FCS in Mode 1 (Power Operation) at 100 percent power, an alarm was received on the Emergency Response Facili
y (ERF) computer, indicating that the upper oil reservoir for Reactor Coolant Pump (RCP) Motor RC-3D-M had reached a level of 85 percent. At 0700, an Instrumentation and Control (I&C) Technician was checking the status of ERF computer data points, utilizing a terminal in the I&C Shop. The technician noticed an increasing trend for the ERF computer data point corresponding to the upper oil reservoir level on RC-3D. The technician's supervisor, the System Engineer and the operating crew were informed of the increasing trend.

At approximately 1030, a containment entry was performed to assess the condition. During the entry, personnel observed foaming from the oil reservoir vent of the RCP motor (RC-3D-M). The Shift Supervisor and System Engineer informed the Plant Manager that it would be necessary to manually trip the reactor and secure pump RC-3D in order to minimize possible damage to the motor bearings. The Shift Supervisor then briefed the operating crew, and preparations were made for the reactor trip, including transferring the feeds for 4160V Buses 1A1 and 1A2 to 161kV

offsite power.

At 1105, the reactor was manually tripped from 100 percent power. Plant response was normal, with systems operating as expected. Both Emergency Diesel Generators started to idle speed, as designed. Emergency Operating Procedure EOP-00, "Standard Post Trip Actions," was entered and RC-3D was secured. EOP-01, "Reactor Trip Recovery," was subsequently performed. At 1225, the NRC Operations Center was notified of the manual reactor trip, pursuant to 10 CFR 50.72(b)(2)(ii).

With the plant in Mode 3 (Hot Shutdown), investigation determined that approximately 15 gallons of CCW had leaked into the RC-3D-M lube oil system. Eddy Current Testing (ECT) and a pressure test were performed on the upper oil reservoir lube oil cooler for RC-3D-M. Two leaking tubes were identified, and a total of six tubes were plugged based on the test results. ECT was also conducted on the corresponding lube oil coolers for the other three RCP motors, and based on the results, four additional tubes were plugged. FCS returned to Power Operation on May 15, 1995.

On May 23, 1995 at 2220, with FCS in Mode 1 at 100 percent power, an RC-3D-M upper oil reservoir high level alarm was again received on the ERF computer. At 2340, Abnormal Operating Procedure AOP-05, "Emergency Shutdown," was entered and a plant shutdown was initiated. Based on the trend of the oil level data and the recommendation of the System Engineer, a decision was made to manually trip the reactor. The operating crew was briefed, and preparations were made for the reactor trip, including transferring the feeds for 4160V Buses 1A1 and 1A2 to 161kV offsite power.

On May 24, 1995 at 0029, the reactor was manually tripped from 97 percent power. Plant systems functioned as designed. Both Emergency Diesel Generators started to idle speed, as designed. EOP-00 was entered and RC-3D was secured. EOP-01 was subsequently performed. At 0203, the NRC Operations Center was notified of the manual reactor trip, pursuant to 10 CFR 50.72(b)(2)(ii).

With the plant in Mode 3, pressure testing of the cooler located an additional heat exchanger tube that had failed, and a decision was made to replace the tube bundles in all four RCP motor upper oil reservoir lube oil coolers. The plant was placed in Cold Shutdown (Mode 4) on May 25, 1995 at 1713.

This report is being submitted pursuant to 10 CFR 50.73(a)(2)(iv).

SAFETY ASSESSMENT

The safety significance of these events was minimal. Upon confirmation of degrading RCP conditions, Control Room Operators initiated conservative actions by manually tripping the reactor and de-energizing the affected pump. These actions were necessary to minimize possible damage to the motor bearings. Following the reactor trips, systems functioned as required.

Failure to take action could have resulted in motor bearing damage and eventually a reactor coolant pump trip. The loss of a single RCP would have resulted in an automatic reactor trip on low coolant flow. Updated Safety Analysis Report (USAR) Section 14.6, "Loss of Coolant Flow Incident," analyzes a low coolant flow condition involving a loss of power to all four reactor coolant pumps. USAR Section 14.6 also analyzes a low coolant flow condition resulting from a seized RCP rotor. Therefore, even if no manual action had been taken in response to the water intrusion into the RCP lube oil, the potential effect on the motor bearings would have been bounded by existing safety analyses.

CONCLUSIONS

A Root Cause Analysis (RCA) was initiated to investigate the lube oil cooler failures that led to the decisions to manually trip the reactor on May 11, 1995 and May 24, 1995. Destructive examination of the failed heat exchanger tubes indicates that the failures involved intergranular stress corrosion cracking associated with nitrites in the CCW. This resulted in circumferential cracking in the grooves between the integral fins of the brass heat exchanger tubes. (The integral fins were machined into the tubes by a process similar to that used in making threaded fasteners.) The tubes had been in service since initial plant startup in 1973.

The ECT results obtained May 12, 1995 indicated no detectable degradation for the tube that was subsequently found to be leaking following the May 24, 1995 shutdown. Circumferential cracking is generally considered difficult to detect via ECT, and would have been especially difficult to detect in this case, due to the integral fin design of the tubes.

CORRECTIVE ACTIONS

Corrective actions taken during the plant shutdown that began May 11, 1995, included performing ECT on 100 percent of the tubes of the four RCP motor upper oil reservoir lube oil coolers, performing a pressure test on

the cooler for RC-3D-M, and plugging a total of ten tubes based on test results. These actions were completed prior to plant restart on May 15, 1995. In response to the subsequent shutdown on May 24, 1995, the decision was made to replace the tube bundles in all four RCP motor upper oil reservoir lube oil coolers. This action was completed prior to plant restart on May 29, 1995. The tubes in the replacement tube bundles do not have the integral fin design.

Additional corrective actions that have been or will be completed include:

1. A review will be performed by July 15, 1995, to identify other heat exchangers that, if they were to experience a tube failure, could necessitate an unplanned plant shutdown.

2. Available options will be assessed to determine appropriate actions to ensure adequate reliability of identified heat exchangers. This assessment will be completed by July 15, 1995.

PREVIOUS SIMILAR EVENTS

In April 1995, the upper oil reservoir lube oil cooler for RCP motor RC-3A-M was determined to be leaking CCW into the RC-3A-M lube oil. This condition was found and the leaking tube was plugged, during the 1995 refueling outage.

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